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Honorable Commissioner of
  Patents and Trademarks
Box **PATENT APPLICATION**
Washington, D.C. 20231

Re: New Patent Application
       ROC9-2000-0220-US1 ALLEN et al.

Dear Sir:

We enclose herewith the application of ALLEN et al. for Letters Patent for STORAGE AREA NETWORK MANAGEMENT AND CONFIGURATION METHOD AND APPARATUS VIA ENABLING IN-BAND COMMUNICATIONS (Case ROC9-2000-0220-US1), including the specification, a set of 18 claims and one copy of the drawings (3 sheets). Also enclosed is the Declaration with Power of Attorney and an Assignment to INTERNATIONAL BUSINESS MACHINES CORPORATION.

We have calculated the filing fee as follows:

Basic fee	$690.00
Additional filing fees:	
1 claims in excess of 20, times $18	0.00
2 independent claims, minus 3,	
times $78	0.00
Assignment Recordal Fee	40.00
	$730.00

Please charge the filing fee and assignment recordal fee in the amount of $730.00 to Deposit account No. 09-0465 of International Business Machines Corporation.

The Commissioner of Patents and Trademarks is hereby authorized to charge any deficiency or credit any overpayment in the above fees to the deposit account No. 09-0465 of International Business Machines Corporation. A duplicate copy of this letter is enclosed.

Respectfully submitted,

By: *Joan Pennington*

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STORAGE AREA NETWORK MANAGEMENT AND CONFIGURATION METHOD AND APPARATUS VIA ENABLING IN-BAND COMMUNICATIONS

Field of the Invention

5   The present invention relates generally to the data processing field, and more particularly, relates to a storage area network (SAN) management and configuration method and apparatus via enabling in-band communications.

Description of the Related Art

10   Some known storage area network arrangements, for example, in a serial storage architecture (SSA), device driver writers and host based adapter (HBA) vendors provide a complex set of micro code calls. A management program would then interrogate the HBA, using micro code calls specific to the particular HBA vendor and model, then interpret the

15   results in a way that is specific to that particular HBA vendor and model.

      One problem with this arrangement is that an in-depth understanding is needed for every HBA model of every vendor, which in the case of Fibre Channel, is impractical. There are too many vendors and too many models to implement this approach.

20   Another problem is that certain HBA models from certain vendors simply cannot support the necessary micro code calls to enable the devices to be managed, and thus prohibiting a SAN management program from

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working with these devices.

A need exists for a mechanism for communicating with devices in-band or over the fibre cable, allowing maximized flexibility, in a vendor and device independent manner.

5   **Summary of the Invention**

A principal object of the present invention is to provide a storage area network (SAN) management and configuration method and apparatus via enabling in-band communications. Other important objects of the present invention are to provide such storage area network (SAN) management and

10   configuration method and apparatus via enabling in-band communications substantially without negative effect and that overcome many of the disadvantages of prior art arrangements.

In brief, a method and apparatus are provided to enable in-band communications for storage area network (SAN) management and

15   configuration. In the storage area network (SAN) management and configuration method, a SAN management application is utilized for communicating with a device driver. A pass through is provided by the device driver through a host bus adapter (HBA), for passing communications to a device in the storage area network from the SAN management

20   application.

The apparatus for enabling in-band communications includes a storage area network (SAN) management application for communicating with at least one SAN-connected host system. Each SAN-connected host system includes a management application agent for communicating with a

25   host bus adapter (HBA) device driver. The HBA device driver is provided for communicating with a device in the storage area network. The HBA device driver includes at least one pass through service for passing a plurality of commands to the device in the storage area network.

In accordance with features of the invention, the management

30   application agent provides predefined, fibre channel standard, protocol functions for communicating with the device in the storage area network.

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The predefined protocol functions include a common transport (CT) protocol function and an extended link service (ELS) protocol function.

Brief Description of the Drawings

5   The present invention together with the above and other objects and advantages may best be understood from the following detailed description of the preferred embodiments of the invention illustrated in the drawings, wherein:

FIG. 1 is a block diagram representation illustrating a storage area network (SAN) system for implementing methods for enabling in-band
10   communications in accordance with the preferred embodiment;

FIG. 2 is a sequence diagram illustrating exemplary logical sequential commands for discover using common transport (CT) and an extended link service (ELS) pass-through services in accordance with the preferred embodiment;

15   FIG. 3 is a diagram illustrating a storage area network (SAN), a fibre channel hierarchy and a management application agent together with the pass-through services in accordance with the preferred embodiment.

Detailed Description of the Preferred Embodiments

Having reference now to the drawings, in FIG. 1, there is shown a
20   storage area network (SAN) system for implementing methods for enabling in-band communications in accordance with the preferred embodiment generally designated by the reference character 100. As shown in FIG. 1, SAN system 100 includes a SAN management application 102 coupled to a SAN connected host system 104 by a communications link 105. SAN
25   connected host system 104 includes an operating system 106 and a management application agents 108 coupled to the SAN management application 102 and a host bus adapter (HBA) device driver 110. Typically SAN management application 102 is remotely coupled to multiple management application agents 108 on multiple SAN connected host
30   systems 104.

HBA device driver 110 includes a common transport (CT) pass-through 112, an extended link service (ELS) pass-through 114 and a small computer system interface (SCSI) protocol driver 116. The CT pass-through 112 and the ELS pass-through 114 are coupled to the management application agents 108 that provides the CT protocol and ELS protocol communications functions. The SCSI protocol driver 116 is coupled to the host operating system 108 for conventional flow control of data. HBA firmware 118 and HBA hardware120 is coupled between the HBA device driver 110 and a storage area network (SAN) 120. SAN 120 includes a fibre channel (FC) fabric and link services 122. The CT pass-through 112 and the ELS pass-through 114 are binary pass-throughs that each takes applied commands and passes the received commands to the SAN 120. CT operations from the management application agents 108 to the FC fabric and link services 122 are indicated by dotted lines. ELS operations from the management application agents 108 to the FC fabric and link services 122 are indicated by dashed lines. A SCSI storage device 124 is shown associated with the SAN cloud 120. FC fabric and link services 122 include multiple switches and hubs for connection of a plurality of FC devices 126 (one shown). FC fabric and link services 122 receive commands from the HBA firmware 118, 120 and sends data back via the HBA firmware 118, 120.

In accordance with features of the preferred embodiment, SAN management application 102 prepares a variety of commands at different levels of fibre channel specification, for example, CT and ELS commands. The SAN connected host system 104 communicates with the management application agents 108 which communicates with the HBA device driver 110 and HBA firmware 118, 120, which communicates with devices 126 in the SAN cloud 120.

In accordance with features of the preferred embodiment, in the SAN connected host system 104, the HBA device driver 110 and HBA firmware 118, 120 support the CT pass-through 112 and the ELS pass-through 114, such that a variety of commands, at different levels of the fibre channel specification, for example CT and ELS protocols, are prepared by the SAN management application agent 108, and passed via the HBA device driver 110 including the CT pass-through 112 and the ELS pass-through 114 and HBA firmware 118, 120 to a designated device where the commands are

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executed. As a result the problem of requiring micro code specific to multiple vendors is avoided. A reply can be generated on the device, and that reply returns to the SAN management program 102 via the same path of the commands.

5   In accordance with features of the preferred embodiment, the SAN connected host system 104 including the HBA device driver 110 and HBA firmware 118, 120 supporting the CT pass-through 112 and the ELS pass-through 114 allow several kinds of commands to be issued. For example, the commands include topology analysis commands, such as what is

10   connected to what, and in what zone, and the like. The commands include performance analysis commands, such as access frame counters, data volume and the like. The commands include attribute analysis commands, such as disk drive number of blocks in use or free. The commands include configuration commands, such as to bring disks on or off line, swap spare

15   disks, archive data, move disks between SAN zones, and the like.

        Referring now to FIG. 2, there is shown a logical sequence diagram illustrating SAN discover using the CT pass-through 112 and the ELS pass-through 114 services. SAN management program 102 issues a discover command to management agents 108 indicated at a line labeled

20   DISCOVER. Management agents 108 issues commands to the HBA device driver 110 indicated at lines labeled CT: GET INTERCONNECTS; CT: GET TOPOLOGY INFO; ELS: GET FC NODE INFO; SCSI INQUIRY; SCSI READCAPACITY; and SCSI GETLUNs (get logical unit numbers). Via pass-throughs 114, 116 commands are issued to the fabric and link services 122

25   indicated at lines labeled (GET INTERCONNECTS); (GET TOPOLOGY INFO); the command (GET FC NODE INFO) is issued to the SCSI storage devices 124 and (GET FC NODE INFO) is issued to the FC device 126. SCSI commands are issued to the storage devices 124 indicated at lines labeled EXECUTE SCSI INQUIRY; EXECUTE SCSI READCAPACITY; and

30   EXECUTE SCSI GETLUNs.

        Referring now to FIG. 3, there is shown the storage area network (SAN) 120 with FC devices 126, a fibre channel hierarchy 300 and the management application agent 108 together with the pass-through services 112, 114 in accordance with the preferred embodiment. The fibre channel

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hierarchy 300 includes from a lower layer to a top layer, a media 302 or wire or optical cable layer coupled to the SAN 120, a physical interface 304, a transmission protocol 306, the fabric and line services 122, common services 308, an upper level protocol (UPL) mapping 310, and the SCSI protocol driver 116. A standard HBA device driver interface 310 is coupled to the SCSI protocol driver 116. The management application agent 108 is coupled to the standard HBA device driver interface 310 and the pass-through services 112, 114. As shown in FIG. 3, the pass-through services 112, 114 in accordance with the preferred embodiment allows bypassing of the standard HBA device driver interface 310 and the upper fibre channel layers including the SCSI protocol driver 116, the upper level protocol (UPL) mapping 310, and the common services 308. The pass-through services 112, 114 passes commands received from the management application agent 108 directly to the fabric and link services 122.

While the present invention has been described with reference to the details of the embodiments of the invention shown in the drawing, these details are not intended to limit the scope of the invention as claimed in the appended claims.

Claims

What is claimed is:

1   1.   A storage area network (SAN) management and configuration
2   method via enabling in-band communications comprising the steps of:
3   utilizing a SAN management application for communicating with a
4   device driver, and
5   providing a pass through by said device driver through a host bus
6   adapter (HBA) for passing communications to a device in the storage area
7   network from said SAN management application.

1   2.   A storage area network (SAN) management and configuration
2   method as recited in claim 1 wherein the step of utilizing said SAN
3   management application for communicating with a device driver includes the
4   step of providing a management application agent coupled between said
5   SAN management application and said device driver.

1   3.   A storage area network (SAN) management and configuration
2   method as recited in claim 2 includes the step of utilizing said management
3   application agent for providing predefined, fibre channel standard, protocol
4   functions for communicating with said device in the storage area network.

1   4.   A storage area network (SAN) management and configuration
2   method as recited in claim 3 wherein the step of providing predefined
3   protocol functions for communicating with said device in the storage area
4   network include the step of providing a common transport (CT) protocol
5   function and an extended link service (ELS) protocol function.

1   5.   A storage area network (SAN) management and configuration
2   method as recited in claim 4 wherein the step of providing a pass through by
3   said device driver through a host bus adapter (HBA) includes the step of
4   providing a common transport (CT) pass through and an extended link
5   service (ELS) pass through by said device driver through said host bus
6   adapter (HBA).

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1   6.   A storage area network (SAN) management and configuration
2 method as recited in claim 1 wherein the step of providing said pass through
3 by said device driver through a host bus adapter (HBA) for passing
4 communications to a device in the storage area network from said SAN
5 management application includes the step of providing said pass through for
6 passing a plurality of commands.

1   7.   A storage area network (SAN) management and configuration
2 method as recited in claim 6 includes the step of providing said pass through
3 for passing at least one topology analysis command.

1   8.   A storage area network (SAN) management and configuration
2 method as recited in claim 6 includes the step of providing said pass through
3 for passing at least one performance analysis command.

1   9.   A storage area network (SAN) management and configuration
2 method as recited in claim 6 includes the step of providing said pass through
3 for passing at least one attribute analysis command.

1   10.   A storage area network (SAN) management and configuration
2 method as recited in claim 6 includes the step of providing said pass through
3 for passing at least one configuration command.

1   11.   A storage area network (SAN) management and configuration
2 apparatus via enabling in-band communications comprising:
3   a storage area network (SAN) management application for
4 communicating with at least one SAN-connected host system;
5   said SAN-connected host system including a management application
6 agent for communicating with a host bus adapter (HBA) device driver;
7   said HBA device driver for communicating with a device in the storage
8 area network; said HBA device driver including at least one pass through
9 service for passing a plurality of commands to said device in the storage
10 area network.

1   12.   A storage area network (SAN) management and configuration
2   apparatus via enabling in-band communications as recited in claim 11
3   wherein SAN-connected host system includes a fibre channel hierarchy and
4   a standard HBA device driver interface.

1   13.   A storage area network (SAN) management and configuration
2   apparatus via enabling in-band communications as recited in claim 12
3   wherein said at least one pass through service bypasses said standard HBA
4   device driver interface and a plurality of upper layers of said fibre channel
5   hierarchy.

1   14.   A storage area network (SAN) management and configuration
2   apparatus via enabling in-band communications as recited in claim 13
3   wherein said plurality of upper layers of said fibre channel hierarchy includes
4   a small computer system interface (SCSI) protocol driver, an upper level
5   protocol (UPL) mapping, and a common services layer.

1   15.   A storage area network (SAN) management and configuration
2   apparatus via enabling in-band communications as recited in claim 11
3   wherein said at least one pass through service for passing said plurality of
4   commands to said device in the storage area network include at least one
5   topology analysis command and at least one attribute analysis command.

1   16.   A storage area network (SAN) management and configuration
2   apparatus via enabling in-band communications as recited in claim 16 further
3   includes at least one performance analysis command and at least one
4   configuration command.

1   17.   A storage area network (SAN) management and configuration
2   apparatus via enabling in-band communications as recited in claim 11
3   wherein said management application agent provides predefined protocol
4   functions for communicating with said device in the storage area network;
5   said predefined protocol functions including a common transport (CT)
6   protocol function.

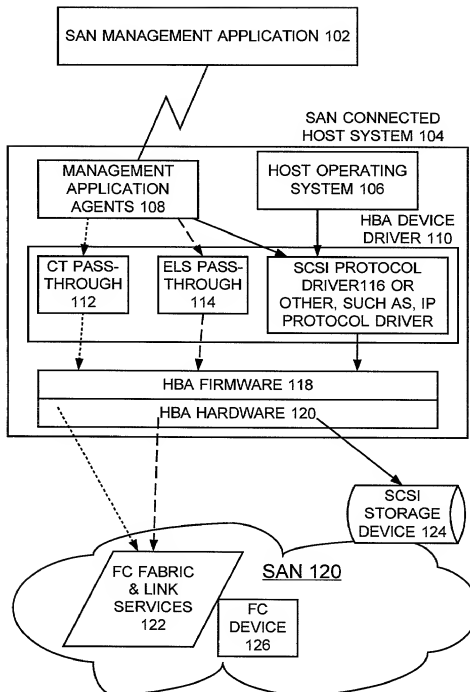1   18.   A storage area network (SAN) management and configuration

2   apparatus via enabling in-band communications as recited in claim 11

3   wherein said management application agent provides predefined protocol

4   functions for communicating with said device in the storage area network;

5   said predefined protocol functions including an extended link service (ELS)

6   protocol function.

STORAGE AREA NETWORK MANAGEMENT AND CONFIGURATION METHOD AND APPARATUS VIA ENABLING IN-BAND COMMUNICATIONS

Abstract of the Disclosure

5   A storage area network (SAN) management and configuration method and apparatus are provided via enabling in-band communications. In the storage area network (SAN) management and configuration method, a SAN management application is utilized for communicating with a device driver. A pass through is provided by the device driver to a host bus adapter (HBA)

10   for passing communications to a device in the storage area network from the SAN management application. The storage area network (SAN) management and configuration apparatus via enabling in-band communications includes a storage area network (SAN) management application for communicating with at least one SAN-connected host system.

15   Each SAN-connected host system includes a management application agent for communicating with a host bus adapter (HBA) device driver. The HBA device driver is provided for communicating with a device in the storage area network. The HBA device driver includes at least one pass through service for passing a plurality of commands to the device in the storage area

20   network. The management application agent provides predefined protocol functions for communicating with the device in the storage area network. The predefined protocol functions include a common transport (CT) protocol function and an extended link service (ELS) protocol function.

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FIG. 1

FIG. 2

FIG. 3

MANAGEMENT APPLICATION AGENT 108
(OR OTHER APPLICATIONS)

STANDARD HBA DEVICE DRIVER
INTERFACE 312

PASS-THROUGH 112, 114

SCSI 116 (OR OTHER ULP)

UPPER LEVEL PROTOCOL (UPL)
MAPPING 310

COMMON SERVICES 308

FABRIC & LINK SERVICES 122

TRANSMISSION PROTOCOL 306

PHYSICAL INTERFACE 304
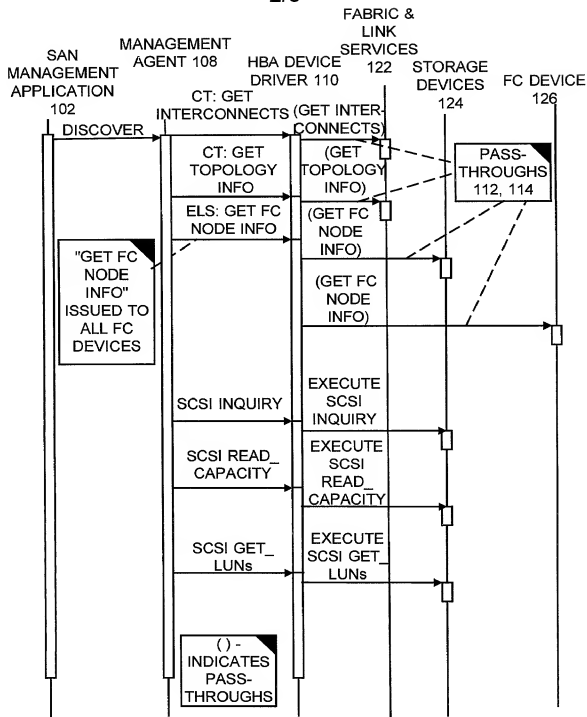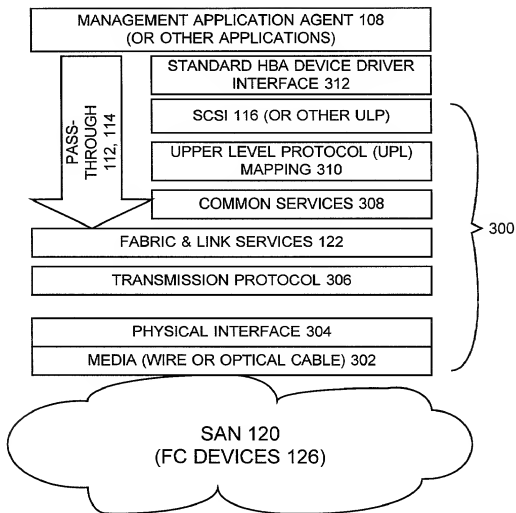
MEDIA (WIRE OR OPTICAL CABLE) 302

300

SAN 120
(FC DEVICES 126)

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

STORAGE AREA NETWORK MANAGEMENT AND CONFIGURATION METHOD AND APPARATUS VIA ENABLING IN-BAND COMMUNICATIONS

the specification of which (check one)

___X___ is attached hereto.

_____ was filed on _____ as

Application Serial No._____

and was amended on _____

<div align="center">(if applicable)</div>

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulation, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)   Priority Claimed

__(NONE)__ _____ _____ ___YES ___NO
 (Number)   (Country)   (Day/Month/Year Filed)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States Application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the

_____ This declaration ends with this page. __X__ Signature for 2nd and subsequent inventors. # pages added __3__

prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information material to the patentability of this application as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT International filing date of this application:

__(NONE)_____   _____   _____
(Application Serial No.)   (Filing Date)   (Status) (Patented, Pending, Abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

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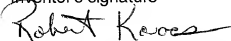
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